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CALIFORNIA DEPARTMENT OF FORESTRY AND FIRE PROTECTION

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Torque Converters

Since we have and are acquiring an increasing number of vehicles, both passenger type and trucks equipped with torque converters and automatic transmission, we thought it appropriate to reproduce an article which appeared in a trade paper published by the J. I. Case Company. Although written with the industrial application in mind, it applies equally to our equipment and is as follows:

STALL SPEEDS AND HEAT RISE IN TORQUE CONVERTERS: What they mean –How they affect performance. Since torque converters are becoming increasingly popular in construction equipment, this article is intended to show you how you can get peak performance and longer life from your torque converter-equipped machines.

What is stall speed? The term “converter stall speed” should not be confused with “engine stall”. The “stall speed” of a torque converter is reached when the output shaft of the converter is stopped by an overload, but when the engine continues to operate at high rpm.

A converter drive is concerned solely with the transmission and multiplication of engine-developed torque. It is not concerned with horsepower. Therefore, the converter is designed so its stall speed will be as close as possible to the engine rpm which produces the maximum engine torque. This stall speed must be at a point where enough engine rpm remains to supply sufficient horsepower to operate hydraulic components.

Maximum multiplication when “stalled. A converter develops maximum torque multiplication when it is stalled, or is slipping the fluid between the impeller and turbine members. The torque-multiplication ratio is the ratio of torque output of the converter to the torque input of the engine.

For example, if you have an engine capable of producing 200 lbs./ft. of torque at stall speed, and the converter is designed with a 2.25-to-1 ratio, you should achieve 450 lbs./ft of torque at the converter output shaft.

Stalling a converter in itself is not detrimental. In fact, many units are designed to utilize the converter stall for intermittent, short-duration periods in their work cycle. The stall, however, can be detrimental if the unit is stalled and HELD THERE for periods of several minutes at a time.

Converter heat rise. There is a direct relation between converter heat rise and input-to-output speed variation. After the temperature of a converter system has reached approximately 170 degrees F, there is approximately 1 degree F rise in fluid temperature for every second the converter remains in a stalled condition . . depending, of course, upon the cooling capacity.

In a completely stalled condition, energy generated by the engine and converter impeller is changed to heat within the fluid. As a result, even though you are getting the maximum push from the tractor, you are not performing any work, you are only generating heat.

One-half engine speed best. To obtain the most efficient converter operation, the output shaft should turn at approximately $\frac{1}{2}$ engine speed. If the output shaft should drop to a speed of less than $\frac{1}{2}$ engine speed, the transmission should be shifted down to reduce the torque requirements and load on the converter. If the output speed rises above $\frac{3}{4}$ engine speed, the transmission should be shifted upward to place the converter back in the efficiency range.

High gear ratios bad. Some operators use the highest gear ratio in which the converter will move the load. As a result, the unit must make a long, sustained pass under constant load. This will often cause the converter to operate continually in a partially stalled state and will result in a very great rise in temperature. Usually this will be noticeable in engine overheating, since the converter fluid is cooled in the heat exchanger portion of the radiator. Shifting the transmission down one gear not only reduce overheating, but will cause the unit to have even higher ground speed than it had while operating in a partial stall at a higher gear ratio.

How to correct malfunctions. If the operator knows the rated stall speed of the converter, there are three malfunctions that can be determined by variations from this specified rpm.

1. Should the stall speed become very high in the converter, resulting in lack of power, the charging pressure within the converter is too low. This could mean either the charging pump is not functioning as it should, or the pressure regulator has stuck in a partially opened condition.
2. If the stall speed of the unit becomes extremely low, pulling the engine down and causing it to lug or even stall, this indicates that the over-run clutch of the stator is faulty and is allowing the stator to turn backwards. A backspinning stator does not redirect the fluid from the turbine to the impeller in the direction in which the impeller is turning and, consequently, acts as a brake against the impeller and slows the engine down.
3. Should the converter stall speed drop one or two hundred revolutions below the rated stall speed, the engine is probably not working efficiently.

4. If the converter runs excessively hot, and shifting to lower gear ratios does not remedy the situation, the cooler lines should be inspected. If these lines are fouled, it may be evident in an increase of converter pressure (unless the system has a pressure regulator). Also, some systems are equipped with a cooler bypass system which opens in case of a fouled cooling circuit. Opening the bypass line and observing the flow will determine if the cooler lines fouled.

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